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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/943,078	08/30/2001	Todd R. Abbott	MIO 0083 PA	7688
7590	10/17/2003		EXAMINER	
Killworth, Gottman, Hagan & Schaeff, L.L.P. Suite 500 One Dayton Center Dayton, OH 45402-2023			KIELIN, ERIK J	
			ART UNIT	PAPER NUMBER
			2813	

DATE MAILED: 10/17/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/943,078

Applicant(s)

ABBOTT, TODD R.

Examiner

Erik Kielin

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 September 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 2-11, 14-16, 39 and 45-49 is/are pending in the application.
- 4a) Of the above claim(s) none is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 2-11, 14-16, 39, 45-49 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Response to Amendment

1. The finality of that action is withdrawn. New grounds of rejection, which respond to the Amendment filed 25 April 2003 and the Amendment filed 30 September 2003, after the Final rejection filed 11 July 2003.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 7, 5, 6, 46, 47, 49, and 14, 15, and 16 are rejected under 35 U.S.C. 102(b) as being anticipated by US 5,844,274 (**Tsutsumi**).

Tsutsumi discloses a method of fabricating a semiconductor device comprising,
forming a first dielectric layer 3, 33, 34 over a base substrate 1 (Figs. 1, 56);
forming a damascene trench 4 in said first dielectric layer 3, 33, 34, said damascene trench having a gate area and a local interconnect area (Figs. 4, 13);
forming a gate oxide layer 9 on said base substrate 1 within said gate area of said damascene trench 4 (Figs. 7, 68);
depositing a conductive layer 10, 14 over said base substrate such that said damascene trench is filled with a conductive material (Figs. 8, 11, 13, 68);

planarizing said device to define a damascene structure including a damascene gate structure and a damascene local interconnect structure electrically coupled by said conductive material within said damascene trench wherein said damascene local interconnect structure forms a connection to said base substrate (Figs. 13, 15-17, 19, 20);

removing said first dielectric layer **3, 33, 34** (Figs. 45, 48, 50, 51, 54, 55, 60, 65); and
providing at least one implant **5b, 11, 13, 21** within said base substrate through said damascene trench (Figs. 2, 10, 11, 23).

Regarding claim 5, **Tsutsumi** discloses a method of fabricating a semiconductor device according to claim 7, wherein said first dielectric layer **3** formation comprises depositing a conformal interlayer dielectric material over said base substrate (Fig. 1).

Regarding claim 6, **Tsutsumi** discloses a method of fabricating a semiconductor device according to claim 7, wherein said damascene trench is formed by “photolithography and etching” (paragraph bridging cols. 13-14), which inherently comprises,

forming a patterned mask over said first dielectric layer;
etching through said first dielectric layer to said base substrate in areas defined by said patterned mask; and
stripping said patterned mask from said first dielectric layer.

This is inherently “photolithography and etching.” (See Van Zant, Microchip Fabrication, 4th ed. McGraw-Hill: New York, 2000, p. 199 for verification.)

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Regarding claim 46, **Tsutsumi** discloses a method of fabricating a semiconductor device according to claim 7, further comprising forming a plurality of local interconnect areas in said damascene trench (Figs. 94-99).

Regarding claim 47, **Tsutsumi** discloses a method of fabricating a semiconductor device according to claim 7, further comprising forming a plurality of gate areas in said damascene trench (Figs. 94-99).

Regarding claim 49, **Tsutsumi** discloses a method of fabricating a semiconductor device according to claim 6, wherein said gate area and said local interconnect area of said damascene trench are both formed by said patterned mask and etching (paragraph bridging cols. 3-4).

Regarding claim 14, **Tsutsumi** discloses a method of fabricating a semiconductor device comprising,

forming a first dielectric layer **3, 33, 34** over a base substrate **1** (Figs. 1, 56);

forming a damascene trench **4** in said first dielectric layer **3, 33, 34**, said damascene trench having a gate area and a local interconnect area (Figs. 4, 13);

forming a gate oxide layer **9** on said base substrate **1** within said gate area of said damascene trench **4** (Figs. 7, 68);

depositing a conductive layer **10, 14** over said base substrate such that said damascene trench is filled with a conductive material (Figs. 8, 11, 13, 68);

planarizing said device to define a damascene structure including a damascene gate structure and a damascene local interconnect structure electrically coupled by said conductive

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material within said damascene trench wherein said damascene local interconnect structure forms a connection to said base substrate (Figs. 13, 15-17, 19, 20);

removing said first dielectric layer **3, 33, 34** (Figs. 45, 48, 50, 51, 54, 55, 60, 65);; and

forming lightly doped drain regions **11** in said base substrate **1** after removing said first dielectric layer, said lightly doped drain regions formed within said base substrate adjacent to said damascene gate structure **10** and said damascene local interconnect structure **10, 14** (Figs. 10, 11, paragraph bridging cols. 2-3).

Regarding claim 15, **Tsutsumi** discloses a method of fabricating a semiconductor device according to claim 14, further comprising forming spacers **12** against the vertical walls of said damascene gate structure **10** and said damascene local interconnect structure **10, 14** (Figs. 10, 11, 13; paragraph bridging cols. 2-3).

Regarding claim 16, **Tsutsumi** discloses a method of fabricating a semiconductor device comprising:

forming a first dielectric layer **3, 33, 34** over a base substrate **1** (Figs. 1, 56);

forming a damascene trench **4** in said first dielectric layer **3, 33, 34**, said damascene trench having a gate area and a local interconnect area (Figs. 4, 13);

forming a gate oxide layer **9** on said base substrate **1** within said gate area of said damascene trench **4** (Figs. 7, 68);

depositing a conductive layer **10, 14** over said base substrate such that said damascene trench is filled with a conductive material (Figs. 8, 11, 13, 68);

planarizing said device to define a damascene structure including a damascene gate structure and a damascene local interconnect structure electrically coupled by said conductive material within said damascene trench wherein said damascene local interconnect structure forms a connection to said base substrate (Figs. 13, 15-17, 19, 20);

removing said first dielectric layer 3, 33, 34 (Figs. 45, 48, 50, 51, 54, 55, 60, 65);; and

forming lightly doped drain regions 11 in said base substrate 1 after removing said first dielectric layer, said lightly doped drain regions formed within said base substrate adjacent to said damascene gate structure 10 and said damascene local interconnect structure 10, 14 (Figs. 10, 11, paragraph bridging cols. 2-3);

forming spacers 12 against the vertical walls of said damascene gate structure and said damascene local interconnect structure (Figs. 10, 11); and

forming doped source/drain regions 13 in said base substrate 1 after forming said spacers such that said base substrate is doped more deeply into said base substrate adjacent to said spacers than into said base substrate underneath said spacers (Figs. 10, 11).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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5. Claims 2, 3, 45, 48 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Tsutsumi** in view of the basic text of **Ghandi**, VLSI Fabrication Principles, 2nd ed., John Wiley & Sons: New York, 1994, pp. 452, 456.

Regarding claims 2 and 39, **Tsutsumi** discloses a method of fabricating a semiconductor device comprising:

forming an isolation region **2** in a base substrate **1**;

forming a first dielectric layer **3** over said base substrate **1**;

forming a first patterned mask over said first dielectric layer (Fig. 2);

etching through said first dielectric layer to said base substrate in areas defined by said first patterned mask to define a damascene trench in said first dielectric layer, said damascene trench having a gate area and a local interconnect area, and positioned such that at least a portion of said damascene trench at least partially overlies said isolation trench (Fig. 2; paragraph bridging cols. 13-14; Figs. 45, 48, 50, 51, 54, 55, 60, 65);

stripping said first patterned mask from said first dielectric layer **3** (Fig. 2; the previous 3 steps are inherent in photolithography and etching as explained above with regard to claim 6);

growing an oxide layer **36** on said base substrate, said oxide layer **36** within said gate area of said damascene trench defining a gate oxide layer (Figs. 7, 68);

forming a second patterned mask **33, 34** over said semiconductor device, said second patterned mask **33, 34** arranged to expose at least a portion of said oxide layer **36** within said local interconnect area;

etching away the exposed portion of said oxide layer **36** within said damascene trench **4**;

providing at least one contact implant **5b, 11, 13, 21** within said base substrate **1** through said damascene trench (Figs. 2, 10, 11, 23);

stripping said second patterned mask from said semiconductor device (Fig. 68; see also Figs. 58-70 and col. 25, line 1 to col. 26, line 20);

depositing a conductive layer **10, 14, 32** comprising a conductive material over said device such that said conductive layer fills said damascene trench **4** (Figs. 13, 68);

planarizing said conductive layer down to the surface of said dielectric layer (Figs. 13, 15-17, 19, 20);

removing said first dielectric layer to define a damascene gate structure and a damascene local interconnect structure **3, 33, 34** (Figs. 45, 48, 50, 51, 54, 55, 60, 65);

forming lightly doped drain regions **11** in said base substrate **1** adjacent to said damascene gate structure **10** and said damascene local interconnect structure **10, 14, 32**;

depositing a spacer layer **12** over said device;

anisotropically etching said spacer layer such that spacers are formed over the portions of said base substrate where said lightly doped drain regions are formed (Figs. 15-17); and

forming doped source/drain regions **13** in said base substrate **1** after forming said spacers **12** such that said base substrate is doped more deeply into said base substrate adjacent to said spacers than into said base substrate underneath said spacers.

Tsutsumi does not state that the oxide isolation film **2** is a “trench” formed “in” the base substrate **1**.

Ghandi teaches that thermal oxidation of the silicon substrate to form SiO_2 reduces leakage current by reducing surface state density (p. 452, section entitled “7.1 Thermal Oxidation

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of Silicon”) is better than deposition for forming oxides on a semiconductor substrate to prevent leakage current generated by dangling bonds at the interface. **Ghandi** also teaches that oxidation consumes the silicon substrate in which it is formed, accordingly the isolation trench is formed “in” the substrate by thermal oxidation (p. 456, section entitled “7.1.3 Oxide formation”).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use thermal oxidation of the base substrate **1** of **Tsutsumi** to form the isolation trench **2**, in order to reduce leakage current, as taught by **Ghandi**. Moreover, because **Tsutsumi** is silent to the method by which the isolation trench **2** is formed, one of ordinary skill would be motivated to use the well known method taught in **Ghandi** to reduce time in research developing a new method.

Regarding claims 3 and 45, **Tsutsumi** discloses a method of fabricating a semiconductor device according to claim 2, wherein at least a portion of said damascene trench at least partially overlies said isolation trench **2** (Figs. 45, 48, 50, 51, 54, 55, 60, 65).

Regarding claim 48, **Tsutsumi** in view of **Ghandi** discloses a method of fabricating a semiconductor device according to claim 2, wherein said isolation trench comprises a shallow trench isolation structure. It is seen to be inherent that because the isolation trench is best formed by oxidation according to **Ghandi**, that the trench is shallow because for a 50 nm isolation trench thickness (as disclosed in **Tsutsumi** at col. 12, lines 53-56), the depth would only be $50 \text{ nm} / 2.27$, or about 22 nm deep, as taught by **Ghandi** based upon the amount of silicon substrate consumed during oxidation (**Ghandi**, p. 456, section entitled “7.1.3 Oxide formation”).

6. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Tsutsumi** in view of US 6,534,393 B1 (**Zhou** et al.).

The prior art of **Tsutsumi**, as explained above, discloses each of the claimed features except for the formation of the of the trench including the steps of:

etching into said base substrate defining an isolation trench opening in said base substrate; and

filling said isolation trench opening with a dielectric material.

Zhou teaches a method of forming gate electrodes **18A** and interconnect **18** in the same trench (Figs. 7A-7C) and forms a shallow trench isolation **12** by etching into the substrate and filling with dielectric (col. 4, last paragraph).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to form the isolation film 2 of **Tsutsumi** using etching a trench and filling with dielectric because **Zhou** teaches that any filed oxide will work to form an isolation region (col. 4, last paragraph). Moreover, there exists no evidence of record to indicate that the isolation trench formed by etching and filling with dielectric material has any unexpected result over any other art know method of forming an isolation trench.

7. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Tsutsumi**.

Tsutsumi discloses a method of fabricating a semiconductor device comprising:

forming a first dielectric layer **3, 33, 34** over a base substrate **1** (Figs. 1, 56);

forming a damascene trench **4** in said first dielectric layer **3, 33, 34**, said damascene trench having a gate area and a local interconnect area (Figs. 4, 13);

forming a gate oxide layer **9** on said base substrate **1** within said gate area of said damascene trench **4** (Figs. 7, 68), wherein said gate oxide-layer formation comprises growing an oxide layer **36** on said base substrate **1** (Fig. 62); forming a patterned mask **33, 34** over said semiconductor device, said pattern arranged to expose at least a portion of said oxide layer **36** within said local interconnect area; etching away the exposed portion of said oxide layer (Fig. 70), and stripping said patterned mask from said semiconductor device (Fig. 68; see also Figs. 58-70 and col. 25, line 1 to col. 26, line 20); depositing a conductive layer **10, 14, 32** over said base substrate such that said damascene trench is filled with a conductive material (Figs. 13, 68); planarizing said device to define a damascene structure including a damascene gate structure and a damascene local interconnect structure electrically coupled by said conductive material within said damascene trench wherein said damascene local interconnect structure forms a connection to said base substrate (Figs. 13, 15-17, 19, 20); removing said first dielectric layer **3, 33, 34** (Figs. 45, 48, 50, 51, 54, 55, 60, 65); and providing at least one implant **5b, 11, 13, 21** within said base substrate through said damascene trench (Figs. 2, 10, 11, 23).

Tsutsumi does not teach forming the implant **21** (Fig. 23) into the substrate **1** prior to stripping said patterned mask.

However, it would have been obvious for one of ordinary skill in the art, at the time of the invention to leave the patterned mask in place during the implantation to protect the dielectric

layer from being implanted with impurities and/or to prevent penetration through the dielectric layer into the substrate yielding undesired implantation regions. Moreover, it has been held that the selection of any order of performing process steps is *prima facie* obvious in the absence of new or unexpected results. See *In re Burhans*, 154 F.2d 690, 69 USPQ 330 (CCPA 1946). No unexpected results are presently of record for this process order.

Response to Arguments

8. Applicant's arguments with respect to all active claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

9. Applicant's amendment **filed 25 April 2003** necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

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however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



Erik Kielin
Primary Examiner
October 11, 2003